

KEY RECENT SCIENTIFIC RESULTS FROM THE OPPORTUNITY ROVER'S EXPLORATION OF ENDEAVOUR CRATER, MARS. R. E. Arvidson¹, S. W. Squyres², R. Gellert³, K. Herkenhoff⁴, D. Mittlefehldt⁵, L. Crumpler⁶, S. McLennan⁷, W. H. Farrand⁸, B. L. Jolliff¹, R. V. Morris⁵. ¹Earth and Planetary Sciences, Washington University in Saint Louis, Saint Louis, MO, 63130, USA, arvidson@wunder.wustl.edu, ²Astronomy, Cornell University, Ithaca, NY, USA, ³University of Guelph, Ontario, N1G 2W1, Canada, ⁴U.S. Geological Survey, Astrogeology Science Center, Flagstaff, AZ 86001, USA, ⁵Astromaterials Research and Exploration Science (ARES), NASA Johnson Space Center, Houston, TX 77058, USA, ⁶New Mexico Museum of Natural History & Science, Albuquerque, NM 87104, USA, ⁷Department of Geosciences, State University of New York, Stony Brook, NY 11794, USA, ⁸Space Science Institute, Boulder CO 80301, USA

The Opportunity Rover is currently in its 11th year of operations, exploring the rim of the ~22 km wide Noachian-age Endeavour Crater. Opportunity spent its 5th winter season in Cook Haven, a gentle swale along Murray Ridge. Two small rocks serendipitously overturned by rover wheel motions show evidence for aqueous precipitation of sulfates, and interaction with a strong oxidant (e.g., O₂) to form a thin, high valence state Mn oxide coating. After the winter, Opportunity headed south to Cape Tribulation and explored Shoemaker formation impact breccias, finding numerous Ca-sulfate veins cutting across outcrops. A key target for Opportunity's measurements has been the Spirit of Saint Louis crater (SoSL), which is ~25 m wide, oval in plan view, shallow, flat-floored, and has a slightly raised rim. SoSL crater is surrounded by an apron of bright, polygonally-shaped outcrops and is superimposed on a gentle swale in Cape Tribulation. Rocks in a thin reddish zone on the rim are enriched in hematite, Si, and Ge, and depleted in Fe, relative to surrounding rocks. Apron rocks include an outcrop also enriched in Si and Ge, and slightly depleted in Fe. In general rocks in the crater and apron have elevated S relative to Shoemaker formation breccias, tracking values observed in the

Cook Haven and the Hueytown (fracture running perpendicular to Cape Tribulation) outcrops. SoSL crater lies just to the west of Marathon Valley, a key target for exploration by Opportunity because five separate CRISM observations indicate the presence of Fe/Mg smectites on the upper valley floor. Opportunity data show that low relief, relatively bright polygonal outcrops dominate the valley floor where not covered by scree and soil shed from surrounding walls. Initial reconnaissance shows that the outcrops are breccias with compositions similar to the typical SoSL crater apron and floor rocks, although only the very upper portion of the valley has been explored as of August 2015. Pervasive but modest aqueous alteration of Endeavour's rim is implied by the combination of CRISM and Opportunity data, providing insight into early aqueous processes dominated in this location by relatively low water to rock ratios, and at least in part associated with enhanced fluid flow along fractures.